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Bemidji’s Natural Choice Farmers Market
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Bemidji, MN

Bemidji Park and Recreation Community Garden
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Rako Site – 424 Rako Street SW

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II. Project Introduction

Every city in America has its share of hungry people. In the United States, 18% of children are reported to live in “food insecure” households (Ladner, 2011). This means that they have no access to healthy food options. From 2006 to 2010, the number of Americans receiving support from food banks, soup kitchens and shelters increased 46% (Ladner, 2011). It is important and necessary for food banks to supply healthy options for the community. In addition, it is important to educate the community about food choices and selecting healthy options. The food industry spends about $1.6 billion on advertising, mainly on unhealthy options full of salt and sugar. The average family in need spends 22% of their grocery money on unhealthy options and 12% on fruits and vegetables. (Ladner, 2011). Largely because unhealthy food options are cheaper than fruits and vegetables. Low-income families often prioritize rent, heat, and transportation costs before food, and food often is the most adjustable portion of the budget (Ladner, 2011).

An opportunity exists for food banks to not only provide healthy options to families in need, but to build the capacity of these families to be able to grow their own food. At times, food banks have been criticized for providing only the cast-off foods from industries, or food with little to no value. Food banks have also been criticized for introducing nutritional food dependency on families, teaching families to accept unhealthy foods, and the mentality that they deserve these options (Ladner, 2011). This criticism reveals the opportunity for food banks to provide fresh produce to families in need and to teach community members how to grow their own food to support a healthy lifestyle.

The goal of this project is to enhance the Bemidji Community Food Shelf by developing local systems for food production, composting and water harvesting. These practices will maximize the productivity of BCFS, and act as an educational center for localized agriculture. This project outlines several ways to teach new skills to the community and strengthen the agriculture movement in Bemidji. This report comprises several sections, each of which act to enhance the goal of self-sustainability for BCFS. Topics covered include agriculture, composting, water harvesting, high tunnels and educational programs. Each topic offers precedents that illustrate what has been achieved by other organizations. This project outlines a path into the future which takes BCFS from being a traditional food shelf to becoming a force for sustainable food systems and practices in the Bemidji community.
III. Project Purpose

The aim of this report is to provide BCFS with the knowledge necessary to organize, implement and benefit from sustainable agricultural practices. The purpose of this project is to outline and illustrate urban agriculture, composting, and water harvesting strategies to enable BCFS to progress over time to become a fully sustainable organization. Three phases are illustrated to show how BCFS can build a sustainable food operation over time. The plan cannot be realized overnight, but can be built over a number of years. The recommendations in this document are achievable with a solid foundation, active community and dedication through time.

This project is intended to provide BCFS with the support to become a center for sustainable food strategies within the Bemidji community, while strengthening the current support network surrounding BCFS. This report aims to provide a framework to assist BCFS to become a key future resource for safe, healthy, local food.

“Cultivators of the earth are the most valuable citizens. They are the most vigorous, the most independent, the most virtuous, and they are tied to their country and wedded to its liberty and interests by the most lasting bands.”

-Thomas Jefferson
Together, BCFS can begin to build a network of Churches, Schools, Markets, Farms, Gardens, and other Supporters. This is an ongoing process and many supporters have been with the BCFS for decades.

The new location and facilities will allow BCFS to progress and grow local food. Along the way, BCFS can help develop skills and distribute more produce. Anything is possible, and new events and festivals can take place celebrating local food and the food network.
It is important to understand the current political and cultural climate in the United States, to better understand how this project at BCFS fits into a larger agricultural movement taking place right now.

The following pages will outline several key concepts and precedents relating to localized agriculture.
Localized Food Production Research

Urban Agriculture

The power behind the urban agricultural movement has been building since the 1950s. Today, it is an enormous power of change and can help reshape and develop communities. The importance of urban agriculture lies not only in the production of food, but also in the development of community values, the development of skills, nutrition and health lessons and the development of self-sufficiency. A large part of the urban agriculture movement is the determination to provide low-income families with healthy options and an agricultural education to enable them to practice self-sufficiency. (Rich, 2012).

As the urban farming movement began to thrive in America, Community Supported Agriculture (CSA) began to form. This type of urban agriculture provides many examples of types of gardening beds and agricultural systems.

Many CSA’s use raised beds to maximize production. Raised beds have numerous benefits such as weed and pest control, better soil conditions, higher yields, increased accessibility, adaptability, frugality and longer growing seasons (McCoy, Mar 8, 2010).

Many urban farms, especially in developing countries, use whatever material they can find to grow vegetables. These Do-It-Yourself systems, or salvaged systems promote creativity and work just as effectively as other agriculture types. A community in Sri Lanka, together with the help of McGill University’s Minimum Cost Housing Group and ETC Energy from Holland, developed a system for growing vegetables using soda bottles, discarded tires, recycled planters, discarded bathtubs and old drain pipes. Anything can be turned into a planter, and even communities in desperate economic situations can begin an urban farm. (Gorgolewski, Komisar, Nasr, 195).
Localized Food Production Research

Square foot gardening is a concept that maximizes space by densely planting produce in the minimum space required. This allows the most food to be produced in the least amount of space. The compactly planted beds minimize weeds and can easily be fitted for cold frames to lengthen the growing season. A 4’x4’ bed can produce enough food to provide one meal for one person a day throughout the growing season. Two 4’x4’ beds can provide that person two meals. Roughly calculated, a family of two adults, one teenager and one child would need a total of 170 square feet, or 10 4’x4’ beds to provide three meals a day (Bartholomew, 10-46).

Aquaponics is a closed loop system that mutually benefits plants and fish.

Aquaponics is a growing method that requires no soil and uses only water to produce vegetables. It is the most common method in North America for mass-producing tomatoes, basil and lettuce. The system uses nutrient rich, oxygenated water to increase the growth rate of plants. (Bernstein, 3). This closed circuit system begins and ends with fish. The fish produce waste, which is eaten by microbes and worms. The microbes and worms then convert the waste to fertilizer, which the plants absorb. The plants also use water, and filter it, returning it to the fish tank. This constructed ecosystem allows plants and fish to thrive. Many aquaponics systems are indoors, but can be outdoors during the summer. (Bernstein, 2).
Localized Food Production Precedents

Community Garden Precedent: Seattle P-Patch Program

Community gardening is popular and thrives in many different urban areas throughout the country. The City of Seattle stands out as a leader in promoting and managing community gardens. The City of Seattle’s Department of Neighborhoods (DON) operates the P-Patch community garden program in cooperation with the non-profit P-Patch Trust. This program has been in operation for over thirty years and supplies 68 gardens within the city containing over 1900 individual garden plots on more than 23 acres of land. These gardens are valued as a foundation for community building and recreation and for their ability to reduce stress, reduce crime, educate children and grow vegetables.

DON encourages residents to seek out and create their own gardens and will assist groups with acquiring or leasing land to create new P-Patch gardens. The department provides guidelines for the consideration of new sites including a 2000 square foot minimum, flat enough land to create level beds through terracing, and full sun. After a group identifies a suitable garden site, P-Patch program staff assist with acquiring access for both public and private lands by dealing with the relevant city agency or through lease negotiation. In addition, program staff help to identify funding opportunities through private foundation grants or public money available for open space.

Through volunteer requirements of P-Patch gardeners, the P-Patch Trust is able to maintain garden facilities as well as provide assistance for the creation of new gardens. The trust also provides program support, advocacy, and disburses several thousand dollars of donations and annual funds that provide tools to gardeners and garden rent support to low income gardeners.

The Seattle P-Patch Program brings communities together to create a strong urban agricultural network.

Education is at the core of the P-Patch Program. Workshops are offered for both adults and children.
Localized Food Production Precedents

Farm and Market Garden Precedent: Growing Power Farm, Milwaukee

Former professional basketball player Will Allen has become a prominent urban agricultural pioneer by developing a model sustainable agricultural operation within an urban context. Located within the city limits of Milwaukee, Allen’s farm, Growing Power, is an intensive agricultural operation utilizing 14 greenhouses on two acres of land that produces herbs, vegetables, fish, and livestock (including goats, bees, ducks, turkeys, and worms).

The operation utilizes a closed-loop system that limits waste and reuses energy from the variety of agricultural elements. The greenhouses are heated, in part, by compost created in an annual reclaimed food waste stream of six million pounds per year. This compost is further digested in large worm bins and turned into worm castings that are used to build up soil for crops. High quality fertilizer is created from nutrient rich water from an aquaponics system used to grow fish like tilapia and perch.

Growing Power sells products at its on-site Growing Power store, farmers’ markets, and to restaurants. In addition to sales, the organization has a strong educational and community building commitment. Middle school and high school students take field trips to the farm to learn about sustainable food systems, healthy nutrition, and the food they eat. Year long gardening and farming activities are available to school children.

Farm and Market Garden Precedent: Chicago: City Farm

On a one and one-quarter acre of vacant city land in Chicago’s Cabrini Green neighborhood a small urban farm flourishes with tomatoes, beets, carrots, herbs, and other vegetables. City Farm has been a revitalizing factor in the neighborhood creating needed green space in an area that is otherwise overrun with concrete. The garden is run by the non-profit Resource Center which operates the farm in part as a permanent demonstration and training facility to teach others about food and urban agriculture. Produce grown on the farm is widely acclaimed for its exceptional quality and is sold to several local restaurants and at an on-site farm stand. Local restaurant Frontera which process salsa for sale on the retail market sources tomatoes through City Farm.

The Growing Power Farm greenhouse providing year long food production. The greenhouses are partially heated by the compost.

An aquaponics system is located in the greenhouse and helps to produce nutrient rich water.

The Chicago City Farm educates the community about urban agriculture and provides fresh produce to local restaurants.
Localized Food Production Precedents

Edible Landscapes Precedent: Earthworks Urban Orchards: Boston

Earthworks is an organization that works with local groups to plant, maintain, and harvest fruit and nut-bearing trees, shrubs, and vines on urban land. The organization concentrates on providing services for neighborhoods with limited resources and in areas where needed landscape improvements can happen quickly. Earthworks will work with communities to plan and plant sites, monitor orchards for at least three years, provide training to residents who will care for trees, and coordinate community maintenance of orchards.

New orchards must have a credible plan for funding and planting as well as a plan to utilize the fruit. Precedence is given to sites whose fruit will be available to the public or persons of lower income. Orchards are planted on publicly accessible land that is owned by non-profit or government agencies (community gardens, schools, public housing developments, urban wilds, etc.) where there is not a reasonable possibility that they will be removed within 15 years. So far Earthworks has planted more than 800 trees and shrubs in urban orchards in the Greater Boston area cities and neighborhoods of Dorchester, Jamaica Plain, Roxbury, Mattapan, Cambridge, and Somerville

In order to maintain its cultural identity and pay homage to its agricultural heritage, the City of Issaquah, Washington developed a landscaping plan for Gilman Boulevard. The end result is a mile long edible landscape tour along the Boulevard that features 25 different varieties of fruit and nut bearing trees that produce food for up to six months in the year. Residents are invited to sample from the trees as they take the tour.

While Gilman Boulevard provides an attractive urban environment and an opportunity to pick and gather a wide range of fruits and nuts, the project requires intensive maintenance. Many plants are not native to western Washington and pose pest and fungus problems.
Composting Basics:

There are many reasons to compost. Landfills are filling up rapidly, and space is valuable. The EPA estimates that 4-10% of purchased food becomes waste, and that Americans throw out 25% of the unprepared food they buy. About two thirds of this waste are fruits and vegetables, milk, grain products and sweeteners (Ladner, 2011). Compost is a valuable resource and has many benefits, from agricultural and environmental to economic. When you mix the compost with normal soil, the result is a nutrient rich soil with a ‘friable’ structure. The friable structure is important for root growth. The soil will also retain water, which will keep plants healthy for longer if a drought occurs. In addition, a nutrient rich soil acts as a slow release plant fertilizer. Plants also benefit for the compost’s microorganisms. The microorganisms improve the plant’s nutrient uptake and help the plants fight disease (Compostguy, 2012).

It is important to note, for BCFS, that compost has been used in some cases to mitigate soils damaged by toxic spills and industrial practices (Kumpiene, Lagerkvist, Maurice, 215). Compost is used as a stabilizing agent that can absorb chemicals. BCFS could consider this technique for the portion of soil behind the warehouse.

There are two different types of decomposition in compost: aerobic and anaerobic composting. Anaerobic composting does not require oxygen, and as a result is often odorous. Many communities deem this method unacceptable due to the odor. With proper management, and a sealed system, this method would produce nutrient rich compost (Hirrel, Smith, Riley, 1993). The other process, aerobic decomposition, requires oxygen, and is often faster and less odorous than the anaerobic process. The microorganisms and invertebrates involved in this system need oxygen and water to ensure their productivity. Products of the aerobic system include: nutrient rich compost, carbon dioxide, heat and water (Hirrel, Smith, Riley, 1993).
Maintaining Healthy Compost

The microorganisms digest carbon (C) as energy and ingest nitrogen (N) as a protein source. The C:N ratio is important as it acts as the microorganism’s food. It is necessary to maintain a pile ratio of about 30 parts C to 1 part N. Composting is a bit like cooking and throwing in ingredients until the compost looks right. The microorganisms need a balanced diet to ensure maximum productivity. The following chart outlines the C:N ratios for common items.

<table>
<thead>
<tr>
<th>Material</th>
<th>C:N Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High N Values:</strong></td>
<td></td>
</tr>
<tr>
<td>Vegetable wastes</td>
<td>12-10:1</td>
</tr>
<tr>
<td>Coffee grounds</td>
<td>20:1</td>
</tr>
<tr>
<td>Grass Clippings</td>
<td>12-25:1</td>
</tr>
<tr>
<td>Cow Manure</td>
<td>20:1</td>
</tr>
<tr>
<td>Horse Manure</td>
<td>25:1</td>
</tr>
<tr>
<td>Poultry Litter</td>
<td>13-18:1</td>
</tr>
<tr>
<td><strong>High C Values:</strong></td>
<td></td>
</tr>
<tr>
<td>Leaves</td>
<td>30-80:1</td>
</tr>
<tr>
<td>Corn Stalks</td>
<td>60:1</td>
</tr>
<tr>
<td>Straw</td>
<td>40-100:1</td>
</tr>
<tr>
<td>Bark</td>
<td>100-130:1</td>
</tr>
<tr>
<td>Paper</td>
<td>150-200:1</td>
</tr>
<tr>
<td>Wood Chips and Sawdust</td>
<td>100-500:1</td>
</tr>
</tbody>
</table>

(Hirrel, Smith, Riley, 1993)

Compost Doctor

Sometimes things can go wrong with the compost pile. The following tips can help fix problems.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Problem</th>
<th>How to Fix it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pile is wet and smells like a mix of rancid butter, vinegar and rotten</td>
<td>Not enough air, or too much nitrogen, or</td>
<td>Turn pile</td>
</tr>
<tr>
<td>eggs (yuck!)</td>
<td>too wet</td>
<td>Add straw, sawdust, or wood chips</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turn pile and add straw, sawdust or wood chips,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>provide drainage</td>
</tr>
<tr>
<td>Pile doesn’t heat up</td>
<td>Pile is too small or pile is too dry</td>
<td>Make pile larger</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Add water</td>
</tr>
<tr>
<td>Pile is damp and sweet smelling but will not heat up</td>
<td>Not enough nitrogen</td>
<td>Add grass clippings or other sources of nitrogen</td>
</tr>
<tr>
<td>Center is dry and contains tough materials</td>
<td>Not enough water</td>
<td>Add water and turn</td>
</tr>
<tr>
<td>Pile is attracting animals</td>
<td>Meat and other animal products have been</td>
<td>Keep meat and other animal products out</td>
</tr>
<tr>
<td></td>
<td>added</td>
<td>enclose pile in 1/4 inch hardware cloth</td>
</tr>
</tbody>
</table>

(Sources: Hirrel, Smith, Riley, 1993)
Composting Precedents

Turning Units

Turning units rely on manually turning the compost to provide a fresh supply of oxygen to the microorganisms. These units can be both large scale and small scale. This type of unit is often found in backyards as it is easy to use and operate.

Turning units need at least three bins to rotate the decomposing compost. Two bins contain compost in different stages of decomposition. One bin is left empty to have a space in which to turn the other piles as needed.

At a large scale, once the compost is done decomposing, it is important to let the pile cure for at least one month. Curing is a process in which the pile is left undisturbed to allow final chemical decompositions to occur (Spiehs, 9 Sept, 2006).

As noted earlier, heat allows compost to decompose faster. The larger the compost pile, the more heat it will retain and the faster the compost will decompose.

Large and small scale turning units can be made out of cement masonry units.

Large scale operations can be easily managed with the help of machinery.

The University of Minnesota's large scale turning unit consists of seven bins, measuring 12 ft deep and 10 ft wide, with 6.5 ft concrete side walls.

Large dairy farm operations use enormous turning units to compost waste.
Composting Precedents

In Vessel Composting: The Earth Tub
Eugene, Oregon

The “Earth Tub” is an in-vessel composting unit that utilizes technology to enhance the speed at which the compost decomposes. The units are designed to decompose non-green feed stocks, such as cafeteria waste (City of Eugene Solid Waste and Recycling Program, 2002). The cover of the tub spins around an auger generated by a motor. The walls of the tub are insulated to trap heat inside. The completely enclosed bin uses biofilter to control odor. These technologies improve the rate at which the waste decomposes and the appeal of composting.

Six middle schools in Eugene, Oregon, had the “Earth Tub” installed near the cafeteria. The tubs can handle 150 pounds of waste per day, and were therefore selected to decompose the cafeteria waste from each school. The middle schools had been paying for waste removal, and the Earth Tubs were projected to save the district $10,000 annually. In addition to saving on waste removal, the tubs were incorporated into the students curriculum to provide education about waste management and composting (City of Eugene Solid Waste and Recycling Program, 2002).

In Vessel Composting: The Hot Box
Brooklyn, NYC

The “Hot Box” technology is based on the principle of aerobic digestion. The design provides constant airflow to the compost inside, allowing the microorganisms to operate at their most efficient rate. The system is enclosed to trap heat inside. In some designs, the top is clear plastic or glass to allow solar heat to increase the composting temperature and improve the rate of decomposition (Regenstein et al, 1999).

The non profit organization, Open Road, utilizes this enclosed system. The Hot Boxes are used at 11 sites in NYC, and Open Road has moved into small scale production mode selling the Hot Boxes. This technology is ideal for a site in NYC, as there is not much available land to use for composting. The Hot Boxes allow for accelerated decomposition while maintaining a small footprint.

The Hot Boxes can be made easily, in a Do-It-Yourself fashion. The materials needed for each Hot Box totals about $300 and takes about 7 hours to put together (Regenstein et al, 1999).
“Make your own worm bin” workshops are currently a popular trend and can be a wonderful educational experience.

Worms don’t like the sunlight. Exposing one half of the worm bin to the sun forces the worms to make their way to the other side.

Composting Precedents

Vermiculture: Worm Composting
Legislative Building, Raleigh, NC

Verminicompost is richer in many nutrients than other kinds of compost.

The best worms for composting are:
Red Wrigglers (Eisenia fetida)
Redworms (Lumbricus ruelius)
Red Tiger (Eisenia andrei)

Using local worms is important as some worms may escape and reproduce outside of the structure.

It takes about 50,000 worms to tackle about 40lbs of food waste per day. It is only necessary to purchase one starting batch of worms, as they reproduce every 120 days.

There are two types of vermiculture systems: vertical and horizontal. The Worm Wigwam, (shown above left) illustrates a vertical system. In this system the worms work their way up to the top layer by layer. When the worms leave a layer, the compost is finished and the crank shakes the fresh product to the bottom, below the grate. This system ensures that the worms never reach the top. The Worm Wigwam provides an endless feast for the worms.

The horizontal system uses a larger bin divided into two equal halves. When one side is ready to be composted, it is covered and the other side exposed. The worms do not like sunlight and will make their way horizontally to the dark uncomposted side. Here they will begin to decompose the waste. The sunlit side can now be emptied and refilled with fresh waste.

To some, Red Wiggles may look gross, but they do their job well and create nutrient rich compost. They are also fascinating to children.
Water Harvesting Research

Water Harvesting Overview

Water harvesting for irrigation is an ancient practice that is being rediscovered and implemented. Many ancient cultures, such as the Greeks and the Native Americans in the Southwest, relied on water harvesting to survive. Today there are several methods and practices of water harvesting. These include permanent ponds that can be used for irrigation, and water tanks that can store water for weeks (Ferguson, 1998). These methods allow water to be used for irrigation when the soil is dry. Capturing runoff directly from a building’s roof allows for a large amount of water to be harvested and stored for later use.

Many systems start small and then expand. Rain barrels are usually the first step in the process. Rain barrels typically hold 55 gallons of water each. PVC pipe can be used to connect the barrels together to increase storage capacity.

Water tanks are designed to capture a larger volume of water. These can be created by hand, purchased or up-cycled from another use. Agriculture tanks are often used as water tanks as they are preconstructed and portable. Ferrocement tanks are also available.

Cisterns are underground water tanks that can provide additional storage. Unfortunately cisterns are expensive to install due to the necessary land excavation.

Rain barrels can be networked together to create a larger capacity system.

The San Antonio Food Bank has two 65,000 gallon tanks that capture a one inch run off event. A drip irrigation system is connected to the tank.

Keith Johnson, a permaculture activist, creates his own ferrocement tank.

Agricultural tanks are often used as water tanks and have large storage capacities.

instructables.com
http://safoodbank.wordpress.com
https://plus.google.com/photos/116559683293608347553/albums/5146779315750225?banner=pwa
gei.newscorp.com
Water Harvesting Precedents

Bradner Gardens Park, Seattle, WA

This 1.6 acre park hosts a variety of gardens from P-Patch plots to urban food demonstration gardens. The park partners with the Master Gardener program and provides visitors with different garden types, such as native prairie gardens, sensory gardens, and butterfly and hummingbird gardens. Further partners include the Seattle P-Patch Program, the Seattle Tilth Association, and WSU Cooperative Extension Master Urban Gardeners.

Water is harvested through a catchment system and flows into a large water tank that is used for irrigation. A pond is also on site to capture additional runoff. A unique aspect of this garden is that it uses a windmill to pump pond water and rainwater into the large water tank. The system is well designed and effective.

Education is another key element on site. The gardens are demonstration gardens and workshops are held to educate the public about agriculture. Rain garden and rainwater harvesting workshops are held as well which help install sustainable practices and values in the community. (City of Seattle, 2012).

Bronx Community and Cultural Garden: Bronx, NYC

This community garden was built on an abandoned lot and founded by residents of the neighborhood. Rainwater is harvested from the 1776 square foot roof of the neighboring church. The 1000-gallon rainwater system is used to irrigate the garden’s plots. In addition to produce, the garden raises chickens and rabbits. The garden is a sustainable source of food for the local community (Garden Mosaics, 2013).

The garden is connected to Abraham House, a program for offenders and their families. The House and Garden aims to provide a safe haven for those in need. Workshops and gardening education are provided and encouraged (Abraham House, 2010).
V. Design Scenarios

The following scenarios and phases outline a practical path for BCFS to reach their goal of sustainability. Three phases are outlined, showing the year-by-year steps needed to reach the goal.

The following page illustrates the basis for all scenarios: studies of sun and shadow. These are especially significant in phase 1 because the placement of the design features, such as compost, planters and the rain catchment system, need to be well placed. The planters and the compost both need sun, therefore these sun and shadow studies are essential to the first phase.
## Design Matrix

<table>
<thead>
<tr>
<th>Design Element</th>
<th>Phase 1: 1 Year</th>
<th>Phase 2: 2 Years</th>
<th>Phase 3: 3+ Years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture</strong></td>
<td>$</td>
<td>$$$</td>
<td>$</td>
</tr>
<tr>
<td>125 Pallet Planters</td>
<td>60 Kiddie Pool Planters</td>
<td>125 Kiddie Pool Planters</td>
<td>Plant an additional 1/4 of field</td>
</tr>
<tr>
<td><strong>Compost</strong></td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Create Three Compost Piles, No Structure</td>
<td>DIY Turning Unit</td>
<td>Purchase Pre-Cast Turning Unit</td>
<td>Network with community to become a &quot;compost hub&quot;</td>
</tr>
<tr>
<td><strong>Rainwater Harvesting</strong></td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Capture 3/4 of Warehouse Runoff</td>
<td>Rain Barrel Network</td>
<td>Purchase Ag Tanks</td>
<td>Install an Underground Cistern</td>
</tr>
<tr>
<td><strong>Extended Growing Season</strong></td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Install 1 Small DIY High Tunnel</td>
<td>Install 1 Medium DIY High Tunnel</td>
<td>Install 1 Large DIY High Tunnel</td>
<td>Purchase or create 2 additional High Tunnels</td>
</tr>
<tr>
<td><strong>Education &amp; Community Development</strong></td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Strengthen Network with Existing Partners</td>
<td>Give Workshops on Planting and Weeding</td>
<td>Provide Workshops on all New Design Elements</td>
<td>Develop a series of workshops that take place each year. These workshops can become a brand for BCFS and encourage public participation.</td>
</tr>
</tbody>
</table>

Network with schools and churches to create a food growing program. The community can grow food for BCFS too!
Sun/Shade Studies

These diagrams show the shadows cast by the buildings and trees on the BCFS site throughout the growing season.
Design Scenarios

Phase 1

1. Compost Turning Units
2. Access Road
3. Picnic Area
4. Water Tank
5. Welcome Sign
6. Pools: Raspberries Bushes
7. Potted Plants
8. Pallet Planters
9. Benches
10. Beans and Peas- Fence as Trellis
11. Hoophouse
12. Pumpkin Patch

Phase 3 Before Adjustments

1. Water Tank
2. Beans and Peas Additional Plantings
3. Hoophouses or High Tunnels
4. Vine Patch
5. Orchard: Fruit Trees
6. Berry Bushes
7. Gathering Spaces
8. Circular Crops
9. Linear Crops
10. Gazebo
11. Buffer Area
Community Meeting Feedback

- Demonstration Garden: Children can pick berries or tomatoes to eat when they arrive.
- Wheelchair Accessible Planters
- Water Tank
- Berry Bushes
- Planters
- Beans and Peas using Fence as Trellis
- Drainage Swale for Runoff
- Path to DAC
- Vine Patch: Pumpkins and Squash
- High Tunnels
- Orchard
- Windbreak Trees
- Circular Crops and Gathering Space
- Linear Crops
- Setback with Native Species
- Deer Fence - 8 ft high

Phase 3 Alterations

- Welcome Garden
- Wheelchair Accessible Planters
- Water Tank
- Berry Bushes
- Planters
- Beans and Peas using Fence as Trellis
- Drainage Swale for Runoff
- Path to DAC
- Vine Patch: Pumpkins and Squash
- High Tunnels
- Orchard
- Windbreak Trees
- Circular Crops and Gathering Space
- Linear Crops
- Setback with Native Species
- Deer Fence - 8 ft high
Phase 1: Agriculture Options

Agriculture Options

The design for Phase 1 allows for 3 options. The options vary, depending on budget, amount of produce desired and management potential.

$ Option: Least Expensive

This option illustrates 125 pallets that have been turned into square foot gardens.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pallets</td>
<td>125</td>
<td></td>
<td>$0.00</td>
</tr>
<tr>
<td>4x10C 100’ Polyethylene Construction Sheeting</td>
<td>3</td>
<td>$35.59</td>
<td>$106.77</td>
</tr>
<tr>
<td>Topsoil</td>
<td>24.7 cu yds</td>
<td>Donated</td>
<td>$0.00</td>
</tr>
<tr>
<td>Compost</td>
<td>7.4 cu yds</td>
<td>$16/cu yr</td>
<td>$118.56</td>
</tr>
<tr>
<td>Coarse Perlite</td>
<td>66.7 cu ft</td>
<td>$5.5/cu ft</td>
<td>$374.00</td>
</tr>
</tbody>
</table>

Total Cost: $600

The soil mixture used for price estimates:

- 60% Topsoil,
- 30% Compost &
- 10% Growing Medium (Perlite or Vermiculite)

Please note: Soil mixtures may vary depending on intended crops and consistency of topsoil. Some alternate mixes are outlined on page 61.

$$ Option:

This option illustrates 60 Kiddie Pools that have been transformed into planter.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiddie Pools</td>
<td>60</td>
<td>$7.99</td>
<td>$479.40</td>
</tr>
<tr>
<td>Topsoil</td>
<td>9.45 cu yds</td>
<td>Donated</td>
<td>$0.00</td>
</tr>
<tr>
<td>Compost</td>
<td>4.71 cu yds</td>
<td>$16/cu yd</td>
<td>$118.56</td>
</tr>
<tr>
<td>Coarse Perlite</td>
<td>42.4 cu ft</td>
<td>$5.5/cu ft</td>
<td>$230.00</td>
</tr>
<tr>
<td>Perlite</td>
<td>10 bags</td>
<td></td>
<td>$100.00</td>
</tr>
</tbody>
</table>

Total Cost: $652.96

$$$ Option: Most Expensive

This option illustrates 125 Kiddie Pools that have been transformed into planters.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kiddie Pools</td>
<td>125</td>
<td>$7.99</td>
<td>$998.75</td>
</tr>
<tr>
<td>Topsoil</td>
<td>7.1 cu yds</td>
<td>Donated</td>
<td>$0.00</td>
</tr>
<tr>
<td>Compost</td>
<td>5.55 cu yds</td>
<td>$16/cu yd</td>
<td>$56.80</td>
</tr>
<tr>
<td>Coarse Perlite</td>
<td>1.18 cu ft</td>
<td>$5.5/cu ft</td>
<td>$176.00</td>
</tr>
</tbody>
</table>

Total Cost: $1231.55

26
How to plant a square foot garden

Square foot gardening (SFG) lets you produce 100% of the crop in 20% of the space. It’s a great way to maximize space of a garden. This method often saves the gardener energy, as there is less ground to cover, and weeds are easier to spot and have less room to grow. SFG is economical as well: it reduces everything 5:1 (SFG, 2013).

Some plants don’t do well in a SFG, such as raspberries, strawberries, blueberries, and blackberries. These should not be planted with other plants because they spread. It is best to build these their own boxes.

Plant larger plants, such as brussel sprouts on the north end of the 4’x4’ planter. These plants will grow and block the sun if on the south side.
How to turn a shipping pallet into a square foot garden:

Anything can be turned into a planter. Shipping pallets are a great source of free wood. With a little work, you can turn a pallet into a planter.

This tutorial illustrates how to turn a shipping pallet into a square foot garden. The end result provides six 1 ft x 1.89 ft squares. You can still apply the square foot gardening planting guidelines to this planter, just use your judgment on plant spacing.

1) Pry off the boards on the pallet top, but leave the two end boards in place (for stability).

2) Pry off the boards on the pallet top, but leave the two end boards in place (for stability).

3) If the boards won’t come loose, you can hammer them from back. Try to keep the boards being taken off in good shape.

4) Nail of screw a spare board to each end of the pallet. Use wood glue to strengthen the bond.

5) Turn the pallet over. Use a staple gun and staple construction plastic to the bottom and sides of the pallet. This will protect the soil and plants from any chemicals on the ground. It will also keep the soil inside the planter.

1) The pallet is on average 4 ft x 4 ft in length and width and 4-6 inches in depth.
6) You will have two remaining boards. Saw these both in half. Use these to divide the pallet into approximately 1 square foot areas. Nail or screw boards in place.

7) Using sandpaper, sand the structure.

8) Fill the pallet with your soil mixture.

9) Plant seeds strategically, according to square foot gardening instructions. You won’t have exact square feet, but 1 ft by 1.83 ft. If you divided the boxes again, they would be 1 ft x 11 inches.

10) Water seeds into soil immediately after planting.

Pallets can be used as vertical planters as well. These can be great for cucumbers, or for planters you wish to lean against a building.
Kiddie Pool “How To”

How to turn a kiddie pool into a planting bed

1) Cut or drill holes in the bottoms of the Kiddie Pools to allow water to exit. Place a few rocks around or on the holes to slow drainage.

2) Put the Kiddie Pools in the locations where you would like them to stay. Once the soil mixture is added, they will be quite heavy and hard to move. Make sure there is at least a 3 ft access path on each side. This will be necessary when gardening later.

3) Fill each Kiddie Pool with soil. Stop filling pools when soil is 3-4 inches from the top.

4) If you wish to make your kiddie pools into square foot gardens, divide pools into square ft at this time.

5) Plant seeds. Follow packet instructions if you do not wish to do square foot gardening. If choosing to plant square foot gardens, follow square foot garden planting guidelines.

6) Water regularly and watch Kiddie Pool Planters grow.
Composting Options:
The design for Phase 1 allows for 3 options. The options vary, depending on the budget.

$ Option: Least Expensive
This option illustrates three large, free-form compost piles. Turning would be necessary, but there would be no structure to contain the compost.

Estimated Cost: $0.00

$$ Option:
A reasonably priced option for composting is to construct your own large scale turning units.

Estimated Cost:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMU</td>
<td>960</td>
<td>$1.65</td>
<td>$1584</td>
</tr>
<tr>
<td>Mortar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rebar</td>
<td>51</td>
<td>$4.78</td>
<td>$243.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$1827.78</td>
</tr>
</tbody>
</table>

An illustration of The $$ Option.

$$ Option: Most Expensive
If the DIY option is not appealing, or if budgeting allows, large scale turning units can be purchased. These are cast elsewhere and shipped to your location.
How to Build Your Own Large Scale Turning Unit

Turning units are often the cheapest form of composting and can be large or small scale. This tutorial is for a large scale composting operation. Each bin measures 20 ft x 10 ft x 15 ft.

1) Level the area needed.

2) It is extremely important to install the foundation properly and correctly. The first block is the most important. This block has to be level at all cost. Everything is based on this block. If this block is crooked, the entire wall will be crooked.

3) You always will build starting from the corner. Install the corner CMU block first. Lay down a mortar bed for the first block to be placed into. Use the mortar to level the block. Tap the block into place. It is critical that this first CMU block is level.

4) Make a mortar bed for the next block. Mortar the ends of the 2nd block. The ends are raised slightly. It's okay to use "too much" mortar.

5) Place the 2nd block. The raised ends should connect with the first blocks raised ends, as shown above. Tap the block into place and check to make sure it's level.

6) Continue until your first row is finished.

7) Install the second row. Make sure you use a running bond pattern for stability. You will need to use a different CMU block for the end of the row. This block will be half of the size of the other CMU. Use a string as a guide to level blocks.

8) Continue until structure is built.

Materials Needed:

Concrete Masonry Units (CMU): 16”x12”x8”
Mortar
Rebar: 1/2” x 10’

Estimated Cost:

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMU</td>
<td>960</td>
<td>$1.65</td>
<td>$1584</td>
</tr>
<tr>
<td>Mortar</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rebar</td>
<td>51</td>
<td>$4.78</td>
<td>$243.78</td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td></td>
<td>$1827.78</td>
</tr>
</tbody>
</table>

15 ft

10 ft

20 ft

String is used as a leveling guide.
Compost Turning Unit Details

Option 1 Details of the Compost Turning Unit

ALTERNATIVE 1
SCALE: 1/8" = 1'-0"

Water catchment basin to collect "compost tea"
Compost Turning Unit Details

Option 1 Details

SCALE: 1/8" = 1'-0"
Compost Turning Unit Details

Option 2 Details of the Compost Turning Unit

ALTERNATIVE 2
SCALE: 1/8" = 1'-0"
Water Tank Options:
The design for Phase 1 allows for 3 options. The options vary, depending on the budget.

$ Option: Least Expensive
Rain Barrels:
Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rain Barrels</td>
<td>15</td>
<td>Donated</td>
<td>$0.00</td>
</tr>
<tr>
<td>PVC</td>
<td>3</td>
<td>$6.60</td>
<td>$19.80</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$19.80</td>
</tr>
</tbody>
</table>

$$ Option:
Purchase Water Tank:
Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500 gal Tank</td>
<td>2</td>
<td>$775.00</td>
<td>$1550.00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$1550.00</td>
</tr>
</tbody>
</table>

$$ Option: Most Expensive
DIY Ferrocement Tank:
Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Price per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welded Wire</td>
<td>6</td>
<td>$69.97</td>
<td>$420.00</td>
</tr>
<tr>
<td>Expanded metal</td>
<td>3</td>
<td>$162.75</td>
<td>$488.25</td>
</tr>
<tr>
<td>Thin welded wire</td>
<td>1</td>
<td>$108.50</td>
<td>$217.00</td>
</tr>
<tr>
<td>Chicken wire</td>
<td>11</td>
<td>$27.10</td>
<td>$298.10</td>
</tr>
<tr>
<td>Rebar</td>
<td>95</td>
<td>$3.98</td>
<td>$378.10</td>
</tr>
<tr>
<td>Concrete</td>
<td>240 ft³</td>
<td>$600-1200</td>
<td>$600-1200</td>
</tr>
<tr>
<td>Tie wire</td>
<td>2 rolls</td>
<td>$7.79</td>
<td>$16.00</td>
</tr>
<tr>
<td>Water seal</td>
<td>5 gal</td>
<td>$57.48</td>
<td>$57.48</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$2474.85</td>
</tr>
</tbody>
</table>

Water Harvesting Options
Photo: Keith Johnson
www.bestbuytoday.com
How to build your own Ferrocement Tank:

Building your own ferrocement tank is often a less expensive option for water storage. Although the construction of the structure is much more labor intensive than installing rain barrels or purchasing a water tank, the tank can be uniquely sized to fit the amount of stormwater runoff from the roof. The estimated time to build the structure is one week for a team of people. Both square and circle tanks can be constructed, but circular structures are stronger and more common.

Ferrocement is a type of construction cement that uses plaster sand. This special mixture of cement includes more steel or fiber which makes it stronger than normal cement (Aquaculture, 2012).

The following tutorial is from The Pace Project and can be found in the reference list at the end of this document (Ferrocement Water Tanks, Action 21).

Materials needed to construct a 2100 sq ft tank:
- Welded Wire ................... 2400 ft²
- Expanded metal ............. 825 ft²
- Thin welded wire ............ 430 ft²
- Chicken wire (roof) ........ 323 ft²
- Reinforcing steel bars .... 85 to 108
- Concrete (floor, roof, wall): 240 ft³
- Tie wire ........................ 2 - 3 rolls
- Water seal (inside):
  - Cement product ........... 155 - 220 lbs
  - Glue .............................. 3-4 gal
  - Hog rings ........................ 5-10 lbs
- Plumbing

1) The Foundation Layer:
   - Level the site and clear it of debris
   - Topsoil is removed to a depth of 100mm

2) The Base Layer
   - The site is covered with 50mm of concrete
   - Wire reinforcement, with steel supports attached, is placed over the concrete before it sets
   - A second layer of concrete is laid over the wire reinforcement to ground level

3) The Wall Frame
   - The wall reinforcement is attached to the steel supports using binding wire
   - For larger tanks, wooden shutterings may be constructed to give added support to the wire frame
Ferrocement Tank “How To”

4) Mesh Frame
- Layers of wire mesh or chicken wire are attached to cover the frame on both the outside and the inside.

5) Fittings
- Fittings are attached to the wire reinforcement before the walls are plastered. The tap below the held securely in place by a plate welded to the pipe and embedded in the ferrocement.
- Additional cement mortar is plastered around the tap to prevent leakage.

6) Plastering
- The tank is plastered with ferrocement on the outside first.
--When the cement mortar is set on the outside, stepladders are used to access the inside of the tank.
- Two coats of plaster are required.

7) Roofs
- Roofs are built following the same steps as the walls of the tank. First rebar, then wall reinforcements, then wire mesh and finally plaster.
- To prevent evaporation, pollution, and the breeding of mosquitoes, all tanks have roofs.
- Roofs that span more than 8 ft require an arched roof or support from a central prop.
Phase 1: Extended Growing Season Options

$ Option: Least Expensive

DIY small hoophouse:
The DIY hoophouse illustrated on the next page is 10’x21’.

Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>$ per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” PVC pipe (16 of 30’ Lengths)</td>
<td>48</td>
<td>$1.49</td>
<td>$72.52</td>
</tr>
<tr>
<td>3/4” PVC pipe (16 of 10’ Lengths) (7 of 34” Lengths)</td>
<td>19</td>
<td>$1.44</td>
<td>$27.36</td>
</tr>
<tr>
<td>3/4” PVC tee connector (3-way)</td>
<td>2</td>
<td>$0.46</td>
<td>$0.92</td>
</tr>
<tr>
<td>3/4” PVC cross connector (4-way)</td>
<td>6</td>
<td>$2.37</td>
<td>$14.22</td>
</tr>
<tr>
<td>20’x25’ plastic</td>
<td>1</td>
<td>$102.00</td>
<td>$102.00</td>
</tr>
<tr>
<td>1” black poly pipe (11’ of 8” Lengths)</td>
<td>2</td>
<td>$50.45 (per 100’)</td>
<td>$100.90</td>
</tr>
</tbody>
</table>

Total: $317.92

$ Option:

Increasing the size of the DIY hoophouse will increase the price, but will usually remain cheaper than buying a kit.

Building Three DIY hoophouses increases the length to 63 ft.

Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>$ per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIY 10’x21’ hoophouse</td>
<td>3</td>
<td>$317.92</td>
<td>$953.76</td>
</tr>
</tbody>
</table>

Total: $953.76

$$ Option:

Building more hoophouses allows you to extend the growing season of more plants.

Building Six DIY hoophouses increases the length to 126 ft.

Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>$ per Item</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>DIY 10’x21’ hoophouse</td>
<td>6</td>
<td>$317.92</td>
<td>$1907.52</td>
</tr>
</tbody>
</table>

Total: $1907.52

Other Options:

Hoophouse kits:

Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>$ per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>16’x20’ Hoophouse Kit</td>
<td>1</td>
<td>$913.00</td>
<td>$913.00</td>
</tr>
</tbody>
</table>

Total: $913.00

Larger Hoophouse Kit:

Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>$ per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>10’x44’ Hoophouse Kit</td>
<td>1</td>
<td>$969.00</td>
<td>$969.00</td>
</tr>
</tbody>
</table>

Total: $969.00

Large High tunnel Kit:

Estimated Cost:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>$ per Item</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>30’x24’ High tunnel Kit</td>
<td>1</td>
<td>$2,997</td>
<td>$2,997</td>
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</tbody>
</table>

Total: $2,997

40
How to Build Your Own Mini High Tunnel

High tunnels and hoophouses are often used to help farmers and gardeners extend their growing season. The structures are just like greenhouses, except are unheated, and rely on the sun for warmth (High tunnels, 2013). During the day, the temperature inside will rise about 5-10 degrees. Often, a plastic sheeting is used instead of glass to cut down on cost. Hoophouses are miniature high tunnels.

This hoophouse costs approximately $317.00. Purchasing hoophouses and high tunnels is an option. A 16’x20’ hoophouse kit is $913.00.

This tutorial is taken from westsidegardener.com. It is for a 10’x21’ hoophouse. The final structure will be 7’ high in the center. Larger designs for high tunnels can be found online at www.hightunnels.org along with more tutorials.

Instructions:

1) Drive a stake into the ground every 36 inches along the two sides (this is much easier if you cut the bottom of the stake at an angle). Try to get them as straight up as possible. It is easiest to put up all the separate hoops first, then connect the ridge afterward. Each of the two end hoops is made using two 10’ lengths of 3/4” PVC, joined with a PVC tee. The other six hoops use the PVC crosses in place of the PVC tees. If you want to be able to move the hoop-house around the garden from season to season, dry-fit the joints together (no glue). They seem to stay together, especially if you use a rubber mallet to snug up all the connections.

2) The two ends of each hoop slide easily over the 1/2” PVC stakes. If the stakes aren’t in the ground perfectly straight, don’t worry about it; the pressure from the hoops tends to even out their alignment somewhat.

3) The next step is to connect the ridge line. Starting at one end of the hoop house, connect the hoops at the top, using the 34-inch sections of 3/4” PVC. Use rubber mallet to set each section as far into the connectors as possible. Note that the ridge line will be slightly shorter than 21 feet, for increased stability.

4) The plastic sheeting can be secured to the frame in many ways. 8-inch lengths of 1-inch black poly pipe can be slit lengthwise, making clips which can hold the plastic onto the PVC frame. A slightly more expensive solution is to use large binder clips, which can be found at any office supply store.

I like to sandwich the sides of the plastic with 2x4 lumber, screwed together. When it gets windy, this extra weight holds the plastic down much better than the clips alone.

5) Cut the 10’x25’ piece of clear plastic to make two 10’x12.5’ pieces. Take one, and lay it over one end hoop of the PVC hoop house (the 10’ measurement should be vertical), such that the hoop is completely covered, but at least one foot of plastic is on the ground. Use the poly pipe clips to secure this plastic end piece to the hoop. Cut a slit down the middle to make the door. There will be some excess plastic, which can be cut off if desired. That’s it! Repeat this at the other end of the PVC hoop house. These “doors” can be tied open with twine, or held shut with weights such as bricks or water jugs (which is why that extra foot of door, laying on the ground, is necessary).

(westsidegardener.com)
Wheelchair Accessible Planter “How To”

Gardening for Everyone

Providing accessible planters for those with limited mobility lets people of all ages and abilities enjoy the benefits of gardening. According to Jean Larson, a horticultural therapist at the University of Minnesota, gardening helps to build hand-eye coordination, and improves range of motion (Hansen, 2013). Gardening provides exercise, but also helps people feel more relaxed and promotes healing.

Accessible planters can be purchased or made by hand. The following tutorial outlines a DIY raised planter. Wheelchair accessible planters can range from 18 inches high to 30 inches high. 24 inches in height is the most typical design. The width should not exceed 4 feet, as the gardener needs to be able to bend to reach the middle from both sides (Hansen, 2013).

Access to the planters needs to be at least 66 inches by 48 inches. Enough space needs to be left available to allow wheelchairs to turn around and move about comfortably. ADA guidelines related to this can be found at http://www.access-board.gov/adaag/html/adaag.htm#4.32.

DIY Wheelchair Accessible Planter:

This tutorial illustrates how to build a 24 inch tall planter. To build a shorter planter, decrease the length of the 4x4 legs. This tutorial is taken from http://www.rhodylife.com/2013/04/diy-raised-bed-planter.html.

Materials:
- 2 - 4”x4” Fir or Cedar post
- 2 - 1”x6”x8” Cedar boards.
- 2 - 1”x4”x8” Cedar boards.
- 1 - 1/4” Hardware cloth that is at least 24” wide.
- 16 - 2” Long hex bolts
- 16 - Washers.
- 16 - 3/8” Threaded Insert Nuts.
- 24 - 1.5” Galvanized Screws
- 1/2” Staples for Staple gun

Cut List:
- Legs - Cut the 4”x4” into 4 - 26” posts.
- Sides: Cut one of the 1”x6”x8” into two 48” pieces.
- Ends: Cut one of the 1”x6”x8” into two 24” pieces.
- Bottom slats: Cut the two 1”x4”x8” into six 24” pieces.
- Bottom hardware cloth: Cut into a 24”x50” rectangle.

These planters can be created in many different dimensions. The most important thing is to have the beds raised for access.
Wheelchair Accessible Planter “How To”

Steps:

1) Gather all of your supplies and tools. Make sure that you have everything listed in the Materials list. These are the tools and pieces that you will need to put together your planter.

2) Cut your wooden boards. If you were unable to have Lowe’s or your local hardware store help out with cutting, you will need to make the cuts to your wood before starting any other aspect of the project. Make sure you remember the golden rule of carpentry - measure twice, cut once.

3) Sand down the corners and edges of your wood.

4) Layout your planter. On a flat and level surface, lay out what your planter would look like if it was placed upside-down. This will help you figure out if you have enough space to work, and how the pieces will fit together. Start with the 4”x4” posts, and stand them up on one edge. Your end boards will go against the two posts, on the outside. You will want the boards to go off the side of the post about 3/4” so that when you put the longer side boards up, they will meet at a 90 degree angle around the post. After you have the side boards up, make sure that your width is accurate by placing one of the bottom support 1x4 pieces across the bottom to make sure they fit.

5) Measure your drill holes for your posts. Since you will be using 2” Hex Bolts on the post, you will need to stagger the holes that you drill so that they do not interfere with each other in the center of the post. Use your measuring tape, mark holes using your pencil at 1.5” and 4” from the bottom of your post, at 3” from the left side. Rotate your post to the right, and then mark holes at 1.5” and 4” from the bottom of your post, at 1” from the left side. This will make sure that your screws do not touch each other in the center of your post.

6) Drill holes in your posts. Using a drill with a 1/2” bit, drill holes where you marked the measurements. Your holes only need to be 1.5” deep, since your hex bolt will be going through another board as well. To help make sure you do not go in too deep with the hole, you can make a mark on the drill bit using a marker or a piece of tape.

7) Screw in the Threaded Insert Nuts For every hole that you drilled into your posts, you will need to add an Insert Nut. These will help make sure that your hex bolts stay in securely. Using a large flat-headed screwdriver, manually screw the insert nuts into the holes. Make sure that they go in straight, and screw them into the wood until they are flush with the surface.
Wheelchair Accessible Planter “How To”

8) Measure your drill holes for your side boards. First, measure the holes for the long side boards. Using your measuring tape, mark holes using your pencil at 1.5” and 4” from the top of the board, at 3” from the right side. Make sure you mark the holes on the side of the board that will be showing on the outside of the planter. For the shorter side boards, mark holes at 1.5” and 4” from the top of the board, at 1.75” from the right side. The reason for the extra 3/4” is because the short boards have a slight overhang from the side of the posts. Make sure you mark the holes on the side of the board that will be showing on the outside of the planter.

9) Drill holes in your side boards. Using a drill with a 1/2” bit, drill holes where you marked the measurements. Your holes will need to go all the way through these boards since the hex bolts will also be going into the posts. Make sure you drill the holes from the side of the board that will be showing on the outside of the planter towards the side that will not be showing. Drill straight down into the wood and try to keep it as level as possible so you don’t break the drill bit.

10) Check your hole placement. Line everything back up, like you did in Step 4, and make sure that the holes that you drilled in the boards match up with the holes in the posts. Adjust holes as needed.

11) Attach your hardware through the side boards. Once your holes line up, start screwing in the hex bolts using a hex wrench. Make sure you put a washer over the bolt before you start twisting it into the side boards. Don’t put the bolts through all the way. You want them to show through to the other side a little bit, but you also want to be able to have enough space on the bolt to thread them into the posts.

12) Attach the side boards to the posts. Once all of your side boards have hex bolts and washers on them, start attaching them to the posts. It is easiest to both side boards to one post, then do the post that is diagonally opposite, so you end up with two “L-shaped” pieces of the planter. Once you have the two “L-shaped” pieces put together, you can attach the longer side boards to the remaining posts. When all of your bolts have been tightened, flip over the planter. Tighten everything one last time.

13) Cut your hardware screen. Using a pair of wire cutters or heavy duty shears, cut a 24”x50” rectangle from your roll of hardware screen. The metal is very sharp, so use caution when cutting this.

14) Attach the hardware screen to the bottom of the planter. Flip the planter back over so that the legs are sticking straight up in the air. Making sure that your screen is centered vertically and horizontally, use your staple gun to staple the screen to the center of all four sideboards.

15) Attach your support boards to the bottom of the planter. Lay out the 1”x4” boards that will be supporting the bottom. Space them out evenly, but you don’t have to be neurotic and measure. Using your 1.5” galvanized screws, screw the boards into place.

Flip your planter back over and admire your work! You’re done!
VI. Final Design

1. Welcome Garden
2. “Pizza Garden”
3. Customer Entrance
4. Back Entrance with Vine Walk
5. Compost Turning Units
6. Back Entrance Path
7. Landscaping Shrubs Shielding Compost
8. Fruit Planters
9. Warehouse Access Path
10. Path from Waiting Area and Shopping Area to Garden
11. Welcome Planter and Sign
12. Wheelchair Accessible Garden
13. Water Tank
14. Pallet Planters or Raised Beds
15. Seating Area
16. Reuse of Fence as Trellis-Planting: Beans and Peas
17. Raised Beds for Raspberries
18. Path to DAC
19. Swale for Excess Water
20. Pumpkin and Vine Patch
21. High Tunnels
22. Three Sisters Gardens
23. Row Crops
24. Gazebo
25. Deer Fence
26. Native Species Planted in 30’ Setback
27. Main Access Road- 8’ Class 5 Gravel
28. Gathering Space
29. Circular Crops
30. Orchard
31. Raised Beds for Fruit Shrubs
32. Spring Ephemerals
33. Water Tank
34. Wind Break Trees and Shrubs
35. Return Path
Planters and Accessible Garden
Path to the DAC
View looking North
View of the High Tunnels and Water Tank
Circular Crops and Gathering Space
View of the Windbreak Trees & Orchard
Perspective of Crops and Orchard
VII. Recommendations

It is recommended to use native species when possible as they are used to the harsh winters and hot summers of Minnesota. Deer can be a problem, and using deer resistant plants is advised. Several species are both native and deer resistant and are highly recommended.

Other recommendations are to use the Three Sisters Garden plan and to make gardening fun by planting Theme Gardens. These are illustrated on the following pages.
Native Plants

The Benefits of Native Plants

Native plants are “naturally occurring, indigenous plants within a specific habitat of a biographic region.”

Native species are an integral part of the food chain because they have developed in this climate and have adjusted to it. Other species have depended on native plants for food and habitat throughout time, mutually benefiting from one another. It is because these species are native and have already adapted that they do not need pesticides once established. These plants usually require less water, time and money. Native species offer stability and increase biodiversity, offering a sustainable option to planting choices.

Minnesota was once a great prairie, with wildflowers and grasses covering its land. Prairie plants have extensive root systems that can survive both drought and flood conditions. These plants are native to Minnesota summers and the fluctuating weather we experience.

Heirloom Seeds

Heirloom seeds can be found through Seed Savers Exchange. The web site is http://www.seedsavers.org. Seed Savers has a yearbook that lists where seeds originated. If you are pursuing seeds that originated in Minnesota, the yearbook is the place to look.

Native Wildflowers

- Achillea millefolium (Common Yarrow)
- Amorpha canescens (Leadplant)
- Antennaria plantaginifolia (Littleleaf Pussytoes)
- Aquilegia canadensis (Columbine)
- Coreopsis tinctoria (Coreopsis)
- Dalea candida (White Prairieclover)
- Dalea purpurea (Purple Prairieclover)
- Echinacea (Purple Coneflower)
- Gaillardia aristata (Blanketflower)
- Geum triflorum (Prairie Smoke)
- Helianthus maximiliani (Maximilian Sunflower)
- Liatris sp. (Blazing Stars)
- Linum lewisi (LewisFlax)
- Lupinus sp (Lupine)
- Monarda fistulosa (BergamotBeebalm)
- Tradescantia occidentalis (Spiderwort)
- Penstemon sp. (Beardtongue)
- Phlox divaricata (Phlox)
- Physotegia virginiana (Obedient Plant)
- Ratibida columnifera (Prairie Coneflower)
- Rudbeckia hirta (Black-eyed Susan)
- Silphium perfoliatum (Cup Plant)
- Symphyotrichum novae-angliae (New England Aster)
- Symphyotrichum laeve (Smooth BlueAster)
- Veronicastrum virginicum (Culver’s Root)

Native Grasses

- Andropogon gerardii (Big Bluestem)
- Andropogon hallii (Sand Bluestem)
- Panicum virgatum (Switchgrass)
- Sorghastrum nutans (Indiangrass)
- Sporobolus heterolepis (Prairie Dropseed)
- Schizachyrium scoparium (Little Bluestem)
- Bouteloua curtipendula (Sideoats Grama)
- Spartina pectinata (Prairie Cordgrass)
- Elymus Canadensis (Canada Wildrye)
- Nasella viridula (Green Needlegrass)
- Koeleria macrantha (Prairie June Grass)
Deer Resistant Plants for MN

Deer Resistant Perennials:

The following is a list of deer resistant perennials specific to Minnesota:

- Achillea spp. (Yarrow)
- Aconitum spp. (Monkshood)
- Anaphalis triplinervis (Pearly Everlasting)
- Amsonia tagernaemontana
- Anemone spp. (Windflower)
- Aquilegia spp. (Columbine)
- Arabis spp. (Cress)
- Aruncus dioicus (Goatsbeard)
- Asclepias tuberosa (Butterfly weed)
- Artemisia spp.
- Aruncus dioicus (Goatsbeard)
- Asclepias tuberosa (Butterfly weed)
- Astilbe spp.
- Aubrietia spp. (False Rockcress)
- Belamcanda chinensis (Blackberry Lily)
- Bergenia spp.
- Boltonia asteroides (Boltonia)
- Calamagrostis (Feather Reed Grass)
- Campanula carpathica (Harebell)
- Chelone glabra (Turtlehead)
- Convolvulus spp. (Creeper)
- Coreopsis spp. (Tickseed)
- Dianthus spp.
- Dicentra spp. (Bleeding Heart)
- Dictamnus albus (Gas Plant)
- Digitalis spp. (Foxglove)
- Dryopteris spp. (Wood Fern)
- Echinacea spp. ( Coneflower)
- Echinops ritro (Globe Thistle)
- Euphorbia spp. (Cushion Spurge)
- Eupatorium (Joe-Pye Weed)
- Filipendula (Meadowsweet)
- Festuca spp. (Blue Fescue Grass)
- Gaillardia spp. (Blanket Flower)
- Gypsophila paniculata (Baby’s Breath)
- Helleborus spp. (Lenten Rose)
- Heuchera spp. (Coral Bells)
- Hypericum spp. (St. John’s Wort)
- Iberis sempervirens (Candytuft)
- Iris spp.
- Liatris (Gayflower)
- Lychnis spp. (Rose Campion)
- Mentha spicata (Spearmint)
- Miscanthus sinensis (Maiden Grass)
- Monarda didyma (Bee Balm)
- Nephrilepis (Sword fern)
- Myrrhis odorata (Sweet Cicely)
- Nepeta spp. (Cat Mint)
- Origanum spp. (Marjoram)
- Paeonia lactiflora (Peony)
- Perovskia spp. (Russian sage)
- Physostegia virginiana (Obedient Plant)
- Polemonium caeruleum (Jacob’s Ladder)
- Pulmonaria (Lungwort)
- Pulsatilla vulgaris (Pasque flower)
- Salvia spp.
- Stachys byzantina (Lamb’s ear)
- Tanacetum (Tansy)
- Trillium spp. (Trillium)
- Veronica spp. (Speedwell)
- Yucca spp. (Yucca)

Biennials:

- Campanula medium (Canterbury Bells)
- Digitalis purpurea (Foxglove)
- Hesperis matronalis (Dame’s Rocket)
- Lychnis (Rose Campion)
- Myosotis sylvatica (Forget-Me-Not)
- Verbascum (Mullein)
- Verbena bonariensis (Verbena)

Shrubs:

- Amelanchier spp. (Serviceberry)
- Arctostaphylos uva-ursi (Bearberry)
- Aronia melanocarpa (Black Chokeberry)
- Berberis spp. (Barberry)
- Buddleia spp. (Butterfly bush)
- Clethra spp. (Sweet pepperbush)
- Cotinus coggygria (Smoke tree)
- Cotoneaster spp. (Cotoneaster)
- Forsythia spp. (Forsythia)
- Juniperus virginiana (Eastern red cedar)
- Pinus Mugho (Mugho Pine)
- Potentilla spp. (Cinquefoil)
- Rhus (Sumac)
- Spirea spp. (Spirea)
- Syringa spp. (Lilac)
- Tamarix ramosissima (Tamarix)
### Deer Resistant Vegetables:
- Asparagus
- Carrots
- Cucumbers
- Eggplant
- Fennel
- Garlic
- Globe Artichokes
- Leeks
- Peppers
- Rhubarb
- Tomatoes
- Onions
- Chives
- Dill
- Lavender
- Lemon Balm
- Mint
- Parsley
- Rosemary
- Sage
- Tarragon
- Thyme

### Semi-Deer Resistant Vegetables:
- Beets
- Bok Choy
- Broccoli
- Brussels Sprouts
- Cabbage
- Cauliflower
- Chard
- Corn
- Kale
- Melons
- Potatoes
- Rutabagas
- Summer Squash
- Winter Squash
- Basil
- Cilantro

### Deer Favorites:
- Apples
- Beans
- Berries
- Lettuce & Leafy Greens
- Peas
- Pears
- Plums
- Strawberries
The Legend of the Three Sisters

The Iroquois believed that corn, beans, and squash were great gifts given to us by the Great Spirit. These gifts are watched over and guarded by the three sister spirits called the “Our Sustainer’s.” Corn provides more energy per acre than any other crop, and was viewed as the main crop. However, the legend of the Three Sisters instructs that corn has to be planted with company in order to prosper. Together, the three plants, corn, beans, and squash, create a balanced environment in which each thrives (Formiga, 2013).

Plant Spacing within Mounds

Diagram of 10’ x10’ Square Of Corn, Beans, and Squash Showing Spacing Of Mounds

10’

5’

S

CB

S

CB

S

10’

S

CB

S

CB

S

CB

S

corn
beans
squash
Theme Gardens

Pizza Garden

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<tr>
<th>Tomato</th>
<th>Parsley</th>
<th>Oregano</th>
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<td>Green Peppers</td>
<td>Red Peppers</td>
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<td>Onions</td>
<td>Garlic</td>
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Taco Garden

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<th>Cilantro</th>
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<td>Jalapeños</td>
<td>Green Peppers</td>
<td>Lettuce</td>
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<td>Onions</td>
<td>Cumin</td>
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Spaghetti Garden

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<th>Tomato</th>
<th>Parsley</th>
<th>Spaghetti Squash</th>
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<td>Onions</td>
<td>Garlic</td>
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Theme gardens are a great way to grab the attention of children and make gardening fun. Whether it is a Pizza Garden, Taco Garden, Spaghetti Garden, or other theme, these gardens will provide the fresh items you need to create a particular meal. Some Pizza Gardens are circular, just like a pizza. Playing with the shape of the garden lets children get even more creative.
VIII. Next Steps

Testing Your Soil

Getting your soil tested is the most important step to building a successful garden. The soil is the basis for all plants, and having balanced soil allows the plants to thrive.

Soil Testing:
- Takes the guesswork out of fertilizer recommendations;
- Makes good economic sense; and
- Ensures fertile soil without excess fertilizer application or pollution of the environment.

“Each soil has had its own history. Like a river, a mountain, a forest, or any natural thing, its present condition is due to the influences of many things and events of the past.”

-Charles Kellogg, The Soils That Support Us, 1956
Soil Testing Process

Soil Testing Laboratory

The University of Minnesota has a Soil Testing Lab that is fast and convenient. It takes about 7-10 days to get the results back from the lab. Generic tests give feedback about soil content, but when growing food, it is important to also test for contaminants, metals, and pollutants.

Location:
Soil Testing Laboratory
Room 135 Crops Research Building
1902 Dudley Ave
St Paul, MN 55108-6089

Phone: 612 625-3101
FAX: 612 624-3420
Email: soiltest@umn.edu

Soil Ingredients:
The ingredients that make up soil can be used like a recipe to mix the perfect soil, or remediate unbalanced soil. Many materials are used in practice to balance and augment soil. The following are some typically used materials to balance soil:

- **Compost** - Adds vital nutrients, microbes, and makes for great soil texture.
- **Peat** - Has excellent moisture-holding properties and is slightly acidic.
- **Manure** - Manure is high in nitrogen and will need to be composted before it can be used, or it will burn plants.
- **Coir** - Made from coconut hulls and is a good substitute for peat.
- **Mulch** - Has moisture holding properties and will keep soil loose. Mulch will break down over time and add nutrients to soil.

www.exponentiaexports.com
www.moremulch.com
www.mountainharvestorganic.com
www.treehugger.com
www.gertens.com

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Soil Mix Suggestions

Soil Mixes
Different plants require different soil mixes. Usually the soil mixes relate to how much water a plant needs. For example, plants which require a lot of water, such as an Iris, needs a different mix than a plant needing drier soil, such as a cactus. The following are soil mixes that are often used in raised beds and square foot gardening:

- **Manure Mix**
  - 1/4 Peat
  - 1/4 Compost
  - 1/4 Natural Soil

- **Economical Soil Mix**
  - 1/3 Compost
  - 1/3 Peat
  - 1/3 Natural Soil

- **Square Foot Gardening Soil Mix**
  - 1/3 Compost
  - 1/3 Peat
  - 1/3 Vermiculite

Mixing your soil can be done by hand using shovels and large containers. The ratios can be used for any size batch of soil.
IX. References


Bartholomew, Mel. All new square foot gardening. Cool Springs Pr, 2006.


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